

Accuracy Characteristics for Final Delivery Scenario Hours 1300-1800 Interfacility

1 Introduction

This document contains scenario characteristics for hours 1300 to 1800 GMT recorded on May 26, 1999 at Memphis ARTCC and cover either the ZME or ZID airspace. Characteristics to be provided are general statistics determined from the scenario on airspace characteristics, aircraft to aircraft and aircraft to airspace encounters, general air traffic, aircraft, flight plan adherence, interfacility traffic flow and deviations in weather forecasts. Definitions of the provided scenario characteristics are provided in Reference[1].

2 Reference

[1] Paglione,M., Oaks,R., Ryan,Dr. H., Summerill,J.S., (Final, January 2000), *Description of Accuracy Scenarios for the Acceptance Testing of the User Request Evaluation Tool (URET) / Core Capability Limited Deployment (CCLD)*, FAA William J. Hughes Technical Center / ACT-250, Atlantic City, New Jersey.

NOTE – Section numbers in this document do not map to those of the reference document.

3 Center Airspace

This section corresponds to Section 3.1 of Reference[1]. The below data corresponds to the ZME Center using the May 20, 1999 ACES chart cycle. Information gathered from running URET PRE, accessing the ZME Center Internet site and local knowledge.

Metric	Definitions	Count
Center Area	Approximate Square Miles	120000
Airports	From URET DU Adaptation List	778
Sectors	From URET DU Adaptation List	110
SAA	Special Activities Airspace	57
APDIA	Automated Problem Detection Inhibited Area	20
SID	Standard Instrument Departure	11
STAR	Standard Arrival Route	10
PAR	Preferential Arrival Route	594
PDR	Preferential Departure Route	346
PDAR	Preferential Departure Arrival Route	124

4 Aircraft Encounter Distributions

The statistics collected in this section characterize aircraft to aircraft encounters. The encounter counts are partitioned by selected minimum horizontal separation intervals, a count of encounters partitioned by standard flight levels, and by vertical phase of flight and aircraft encounter angle. This section corresponds to Section 3.2.1 in Reference[1].

4.1 Count Partitioned by Minimum Horizontal Separation

This section corresponds to Section 3.2.1.1 in Reference[1].

Table 1: Count of Current Plan Aircraft Encounters

Min. Horz. Separation (nm)	Without Adherence	13 Minutes Adherence
$0 \leq d < 5$	159	96
$5 \leq d < 10$	203	111
$10 \leq d < 15$	247	143
$15 \leq d < 23$	523	299
$23 \leq d < 30$	410	243
Total	1542	892

Table 2: Count of Trial Plan Aircraft Encounters

Min. Horz. Separation (nm)	Without Adherence	20 minutes Adherence
$0 \leq d < 5$	159	93
$5 \leq d < 10$	203	107
$10 \leq d < 15$	247	134
$15 \leq d < 24$	575	310
$24 \leq d < 30$	358	206
Total	1542	850

4.2 Count Partitioned by Altitude for Standard Separation Intervals

This section corresponds to Section 3.2.1.2 of Reference[1].

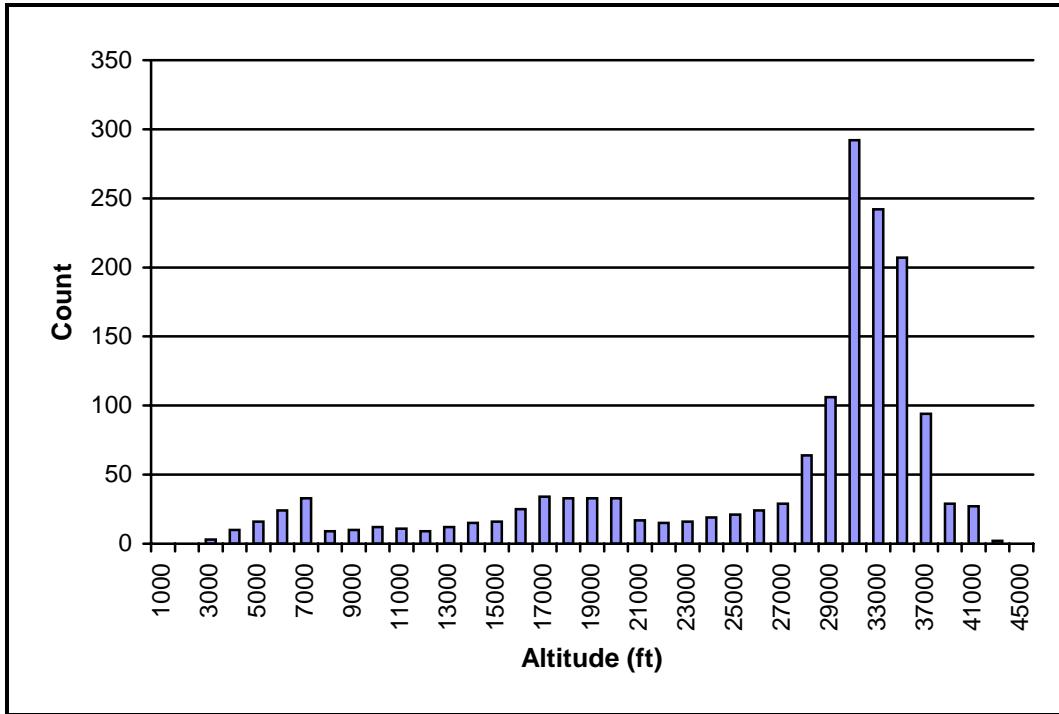


Figure 1: Aircraft to Aircraft Encounters by Altitude

4.3 Count Partitioned by Vertical Phase of Flight and Encounter Angle

This section corresponds to Section 3.2.1.3 of Reference[1].

Table 3: Count of Aircraft Encounters Partitioned by Phase of Flight and Encounter Angle

Vertical Phase	Encounter Angles (deg)				Total
	[0, 45)	[45, 90)	[90, 135)	[135, 180]	
Cruise-Cruise	124	108	72	43	347
Descend-Descend	39	16	6	8	69
Climb-Climb	35	7	7	11	60
Cruise-Climb	161	88	91	101	441
Cruise-Descend	153	104	92	119	468
Climb-Descend	36	29	20	48	133
Unknown	10	6	4	4	24
Total	558	358	292	334	1542

5 Airspace Encounter Distributions

This section provides statistics on aircraft to airspace encounters. Three areas considered are counts partitioned by selected minimum horizontal separation intervals, an encounter count partitioned by standard flight levels, and a count partitioned by vertical phase of flight and airspace encounter angle. Additionally, vertical phase of flight count is separated into top, bottom and side airspace encounters and for encounters with unknown encounter angles. The section corresponds to Section 3.2.2 of Reference[1].

5.1 Count Partitioned by Minimum Horizontal Separation

The section corresponds to Section 3.2.2.1 of Reference[1].

Table 4: Count of Current Plan Airspace Encounters by Horizontal Separation

Min. Horz. Separation (nm)	Without Adherence	13 minutes Adherence
Conflicts ¹	2344	2003
$d = 0^2$	40	33
$0 < d < 7$	856	687
$7 \leq d < 9$	232	182
$9 \leq d < 11$	195	144
$11 \leq d < 16$	547	443
$16 \leq d < 30$	1862	1468
Total	6076	4960

Table 5: Count of Trial Plan Airspace Encounters by Horizontal Separation

Min. Horz. Separation (nm)	Without Adherence	20 minutes Adherence
Conflicts ³	2344	1963
$d = 0^4$	40	32
$0 < d < 8$	979	768
$8 \leq d < 11$	304	230
$11 \leq d < 13$	195	153
$13 \leq d < 19$	747	590
$19 \leq d < 30$	1467	1117
Total	6076	4853

¹ This count includes encounters that are conflicts. By definition the minimum horizontal separation is zero and the track point actually penetrates the airspace.

² This count includes encounters without valid airspace penetrations, which occurs under two cases: a short duration penetration or an encounter on the actual buffered boundary of the airspace which does not penetrate.

³ This count includes encounters that are conflicts. By definition the minimum horizontal separation is zero and the track point actually penetrates the airspace.

⁴ This count includes encounters without valid airspace penetrations, which occurs under two cases: a short duration penetration or an encounter on the actual buffered boundary of the airspace which does not penetrate.

5.2 Count Partitioned by Altitude

This section corresponds to Section 3.2.2.2 of Reference[1].

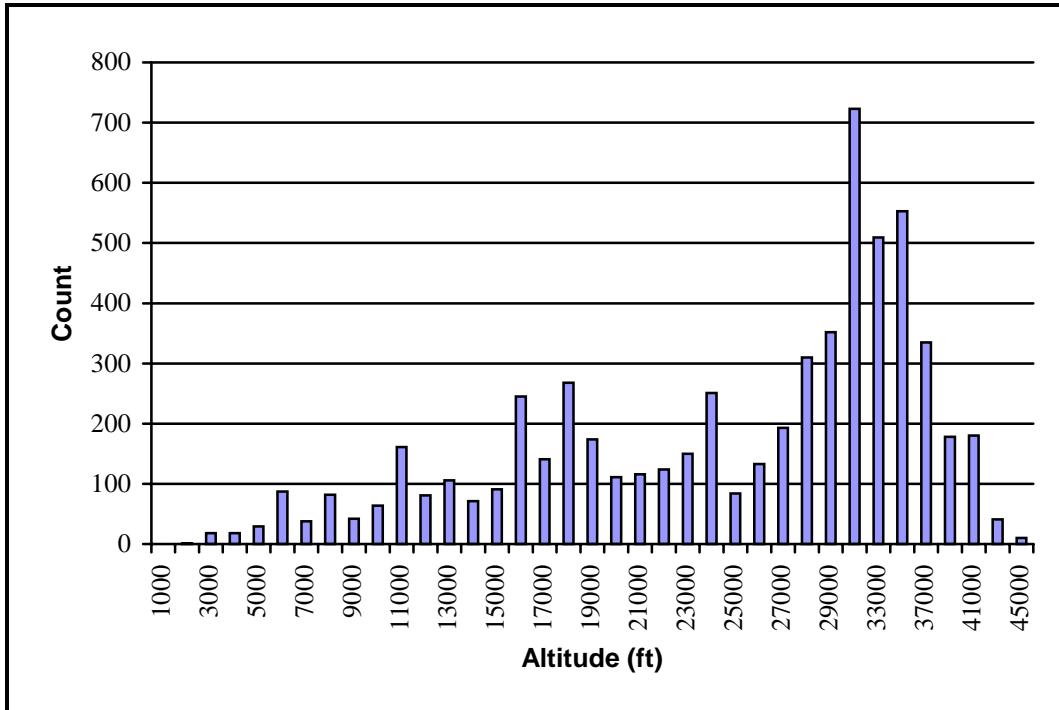


Figure 2: Airspace to Airspace Encounters by Altitude

5.3 Count by Vertical Phase of Flight and Encounter Angle

This section corresponds to Section 3.2.2.3 in Reference[1].

Table 6: Count of Airspace Encounters by Angle and Vertical Phase of Flight for Side Conflicts

Vertical Phase	Encounter Angles (deg)			Total
	[0, 30)	[30, 60)	[60, 90)	
Climb	18	68	124	210
Cruise	155	610	765	1530
Descend	16	66	68	150
Total	189	744	957	1890

Table 7: Count of Airspace Encounters by Angle and Vertical Phase of Flight for Top and Bottom Conflicts

Vertical Phase	Encounter Angles (deg)			Total
	[0, 30)	[30, 60)	[60, 90)	
Climb	156	0	0	156
Cruise	0	0	0	0
Descend	20	0	0	20
Total	176	0	0	176

Table 8: Count of Airspace Encounters by Vertical Phase of Flight with Unknown Angles

Vertical Phase	Count
Climb	60
Cruise	184
Descend	34
Total	278

6 Air Traffic Distributions

This section provides metrics that characterize the air traffic. The metrics are flight density partitioned by standard flight levels, flight type and sector penetration, statistics on the number of active flights, ground speed statistics, counts of interim altitude and amendment messages, and air traffic maneuvers by altitude and phase of flight. This section corresponds to Section 3.3 of Reference[1].

6.1 Air Traffic Density

This section corresponds to section 3.3.1 of Reference[1]. Detailed statistics on aircraft encounters are provided in Appendix A.

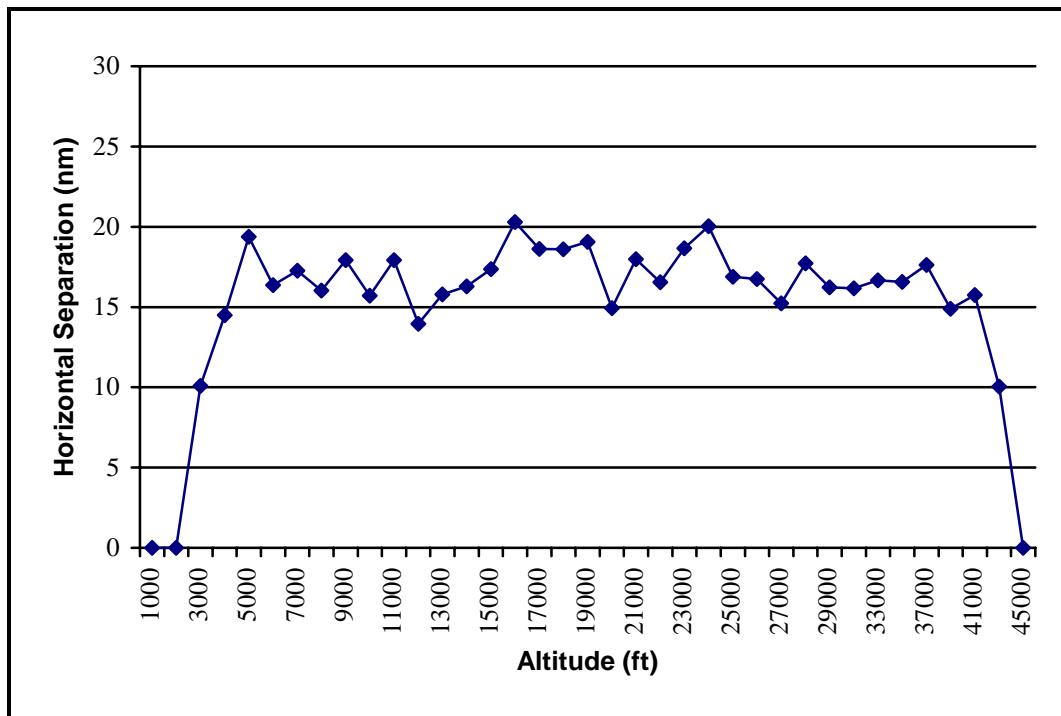


Figure 3: Average Horizontal Separation by Altitude for All Hours

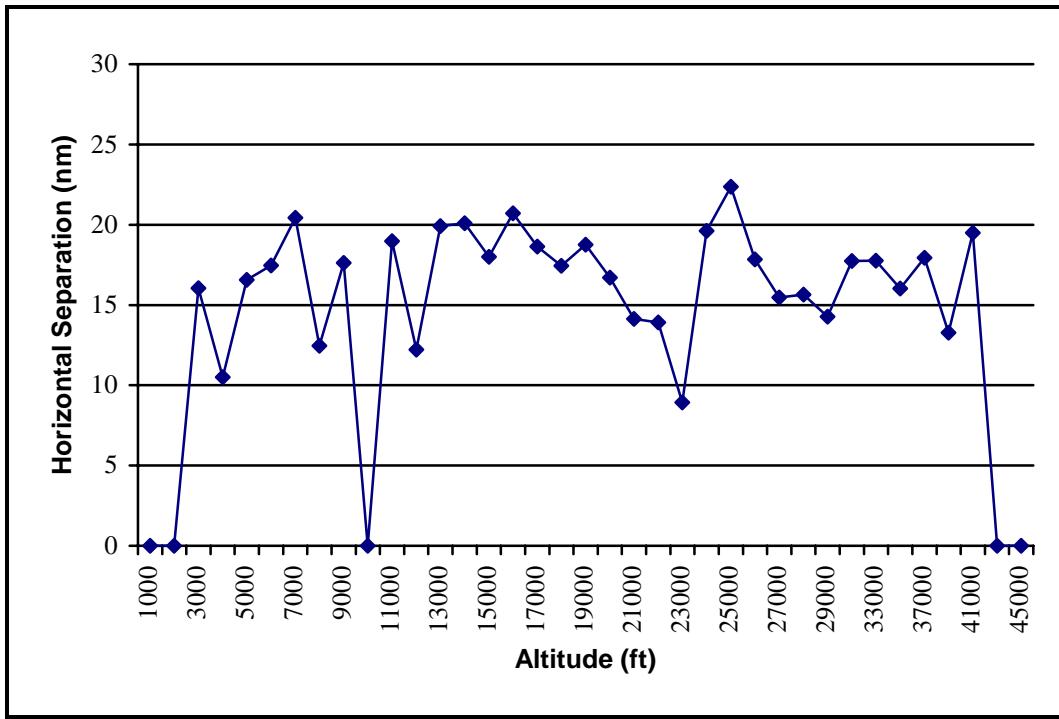


Figure 4: Average Horizontal Separation by Altitude for Hour 1

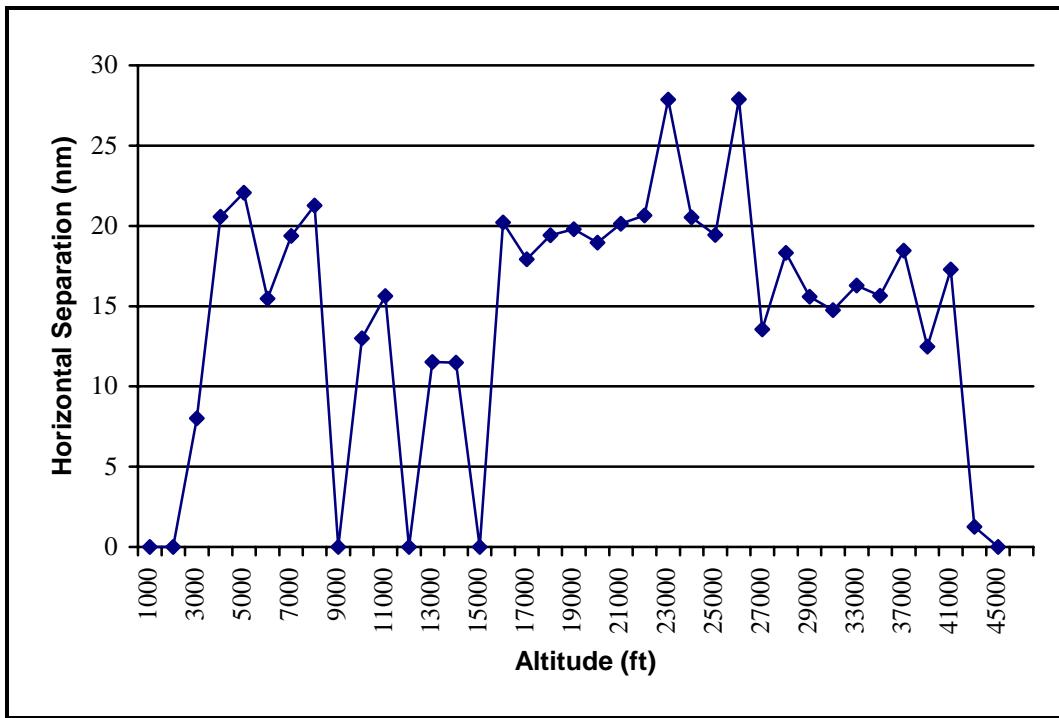


Figure 5: Average Horizontal Separation by Altitude for Hour 2

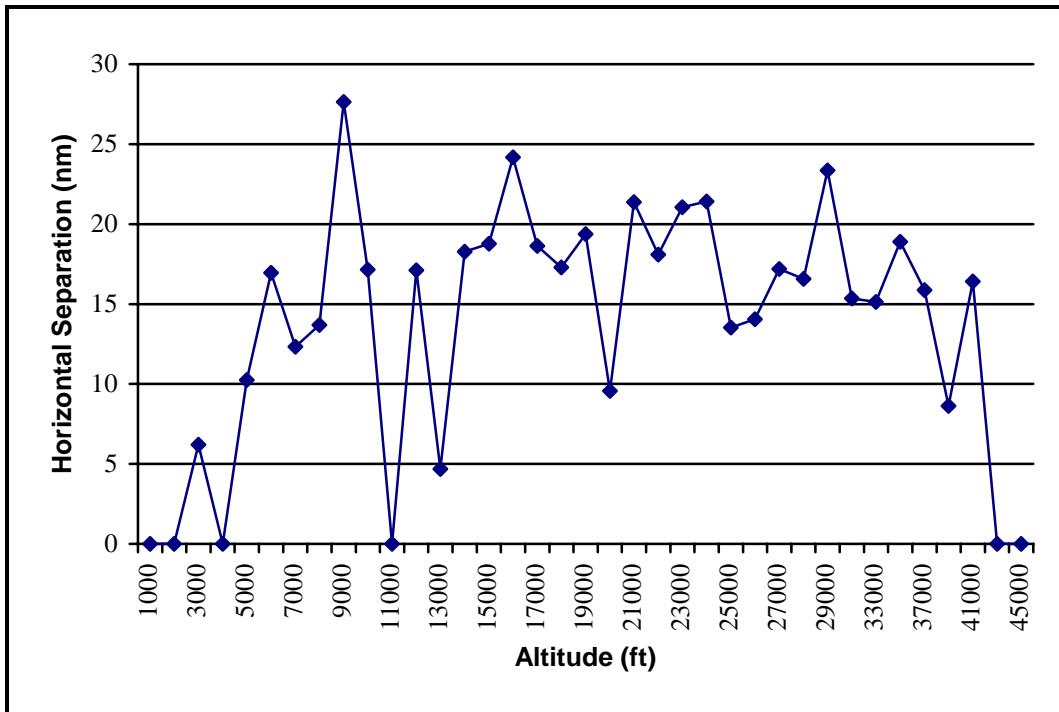


Figure 6: Average Horizontal Separation by Altitude for Hour 3

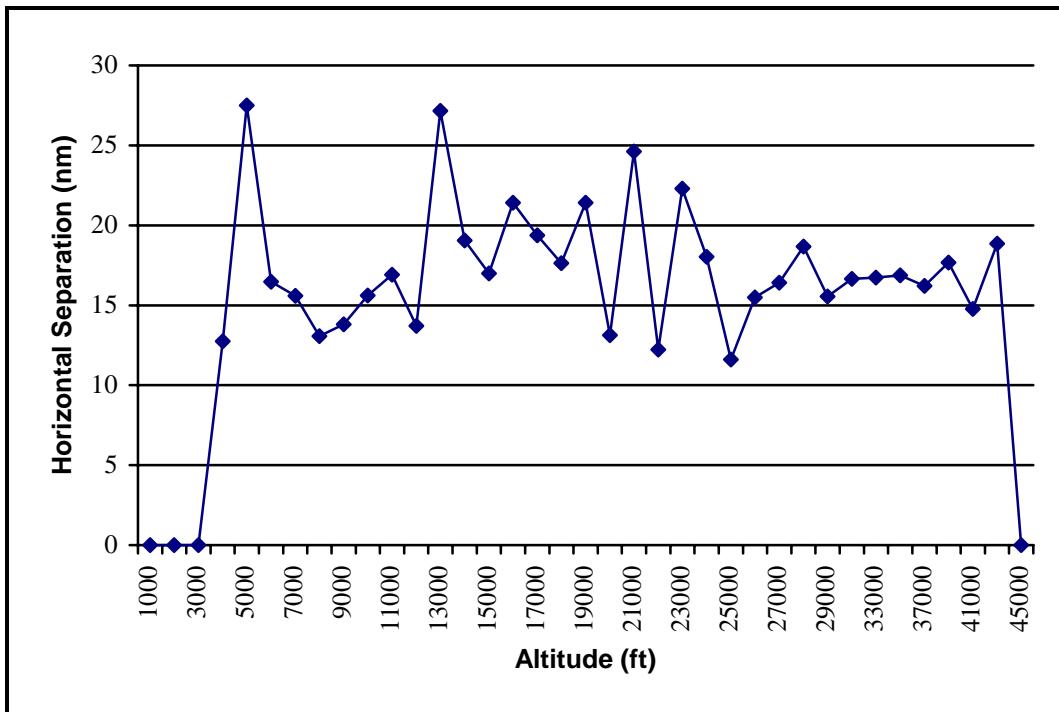


Figure 7: Average Horizontal Separation by Altitude for Hour 4

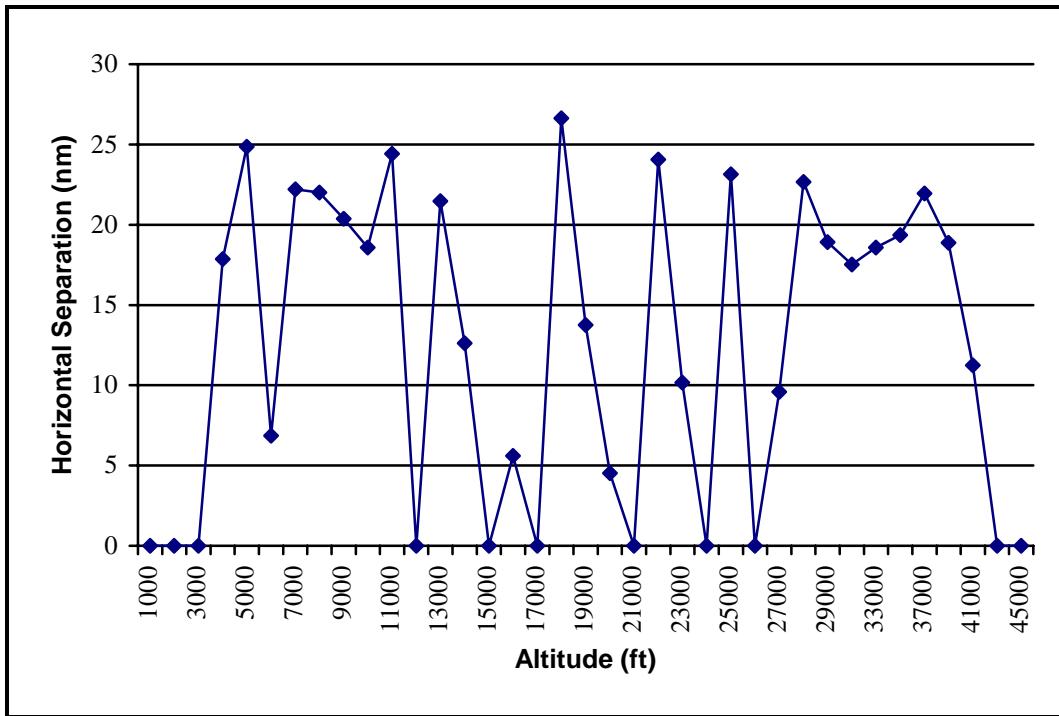


Figure 8: Average Horizontal Separation by Altitude for Hour 5

6.2 Active Flights

This section corresponds to section 3.3.2 of Reference[1].

Table 9: Statistics on Active Flights per Minute Increment

Count Average	Standard Deviation	Maximum Count	Minimum Count
186.927	78.860	283	0

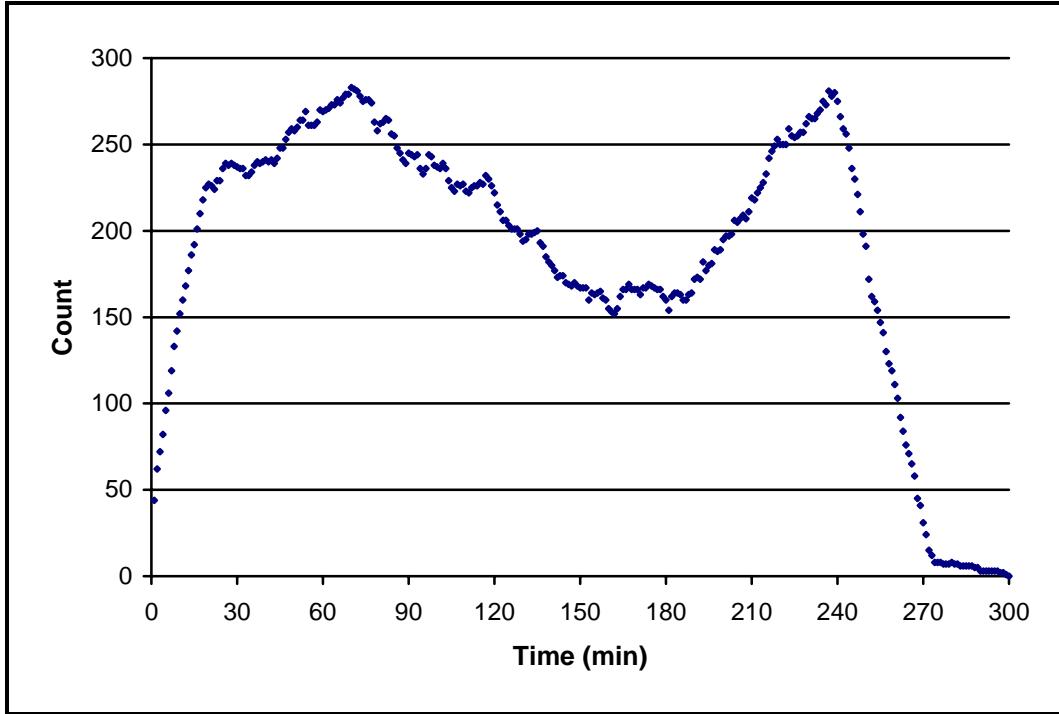


Figure 9: Count of Active Flights per Minute Increment

6.3 Flight Type and Sector Penetration

This section corresponds to Section 3.3.3 of Reference[1].

Table 10: Statistics on Sector Time, Center Time and Sector Penetration by Flight Type

Metric	Arrivals	Departures	Internals	Overflights	All Flights
Average Number of Sectors Penetrated	2.043	2.219	1.952	2.462	2.284
Average Time in Center (sec)	1385.061	1268.830	1457.905	1779.646	1559.798
Average Time in Sector (sec)	658.612	554.941	708.829	710.560	666.892
Percentage by Flight Type	21.300	22.300	6.800	49.600	100.000

6.4 Ground Speed

This section corresponds to Section 3.3.4 of Reference[1]. Detailed statistics on aircraft ground speed are provided in Appendix B.

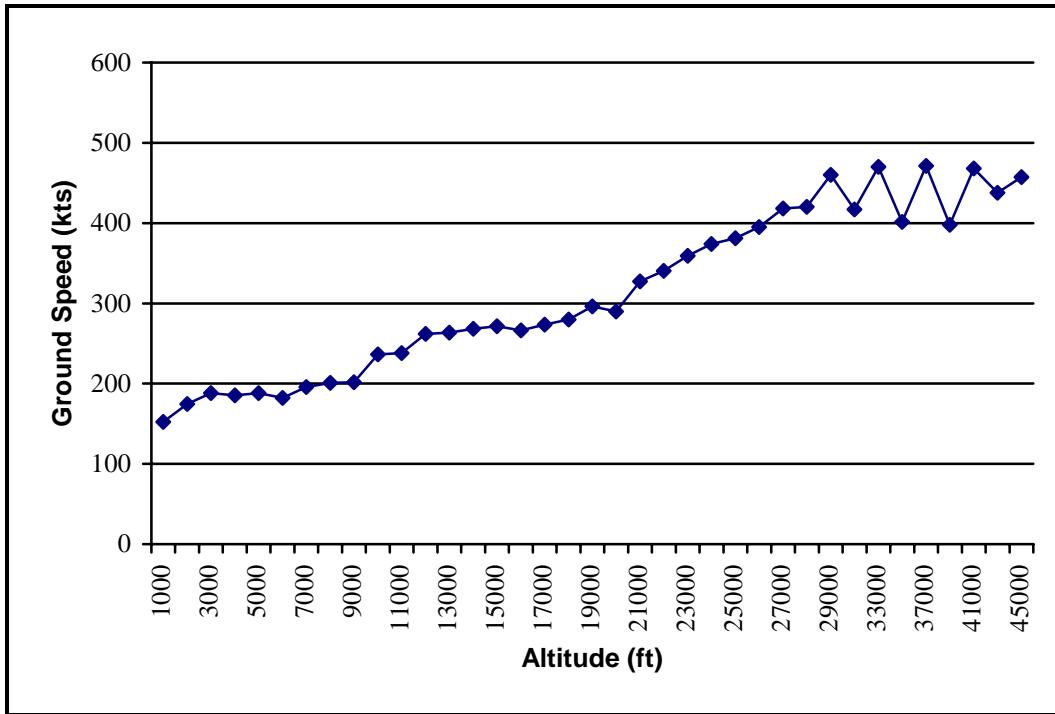


Figure 10: Average Ground Speed by Altitude for All Hours

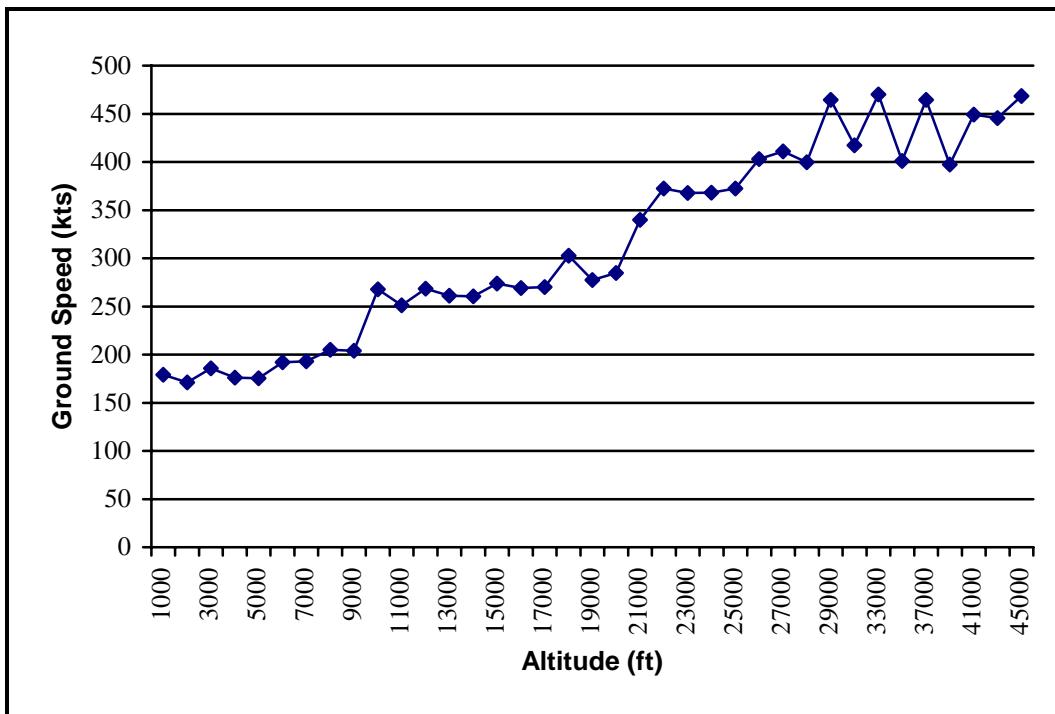


Figure 11: Average Ground Speed by Altitude for Hour 1

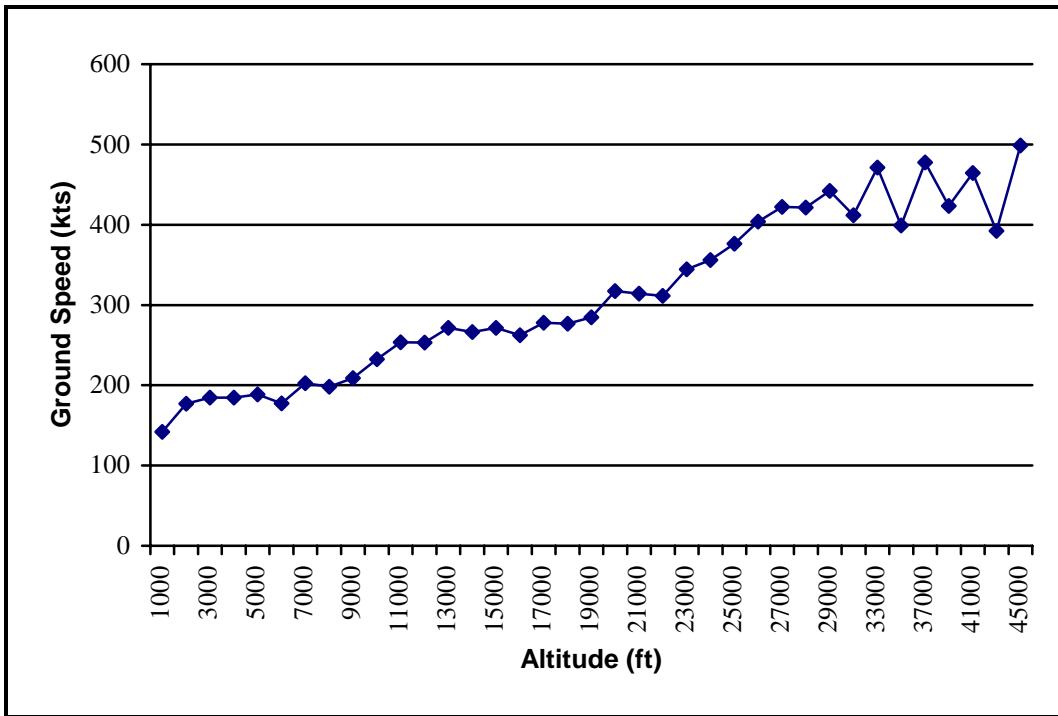


Figure 12: Average Ground Speed by Altitude for Hour 2

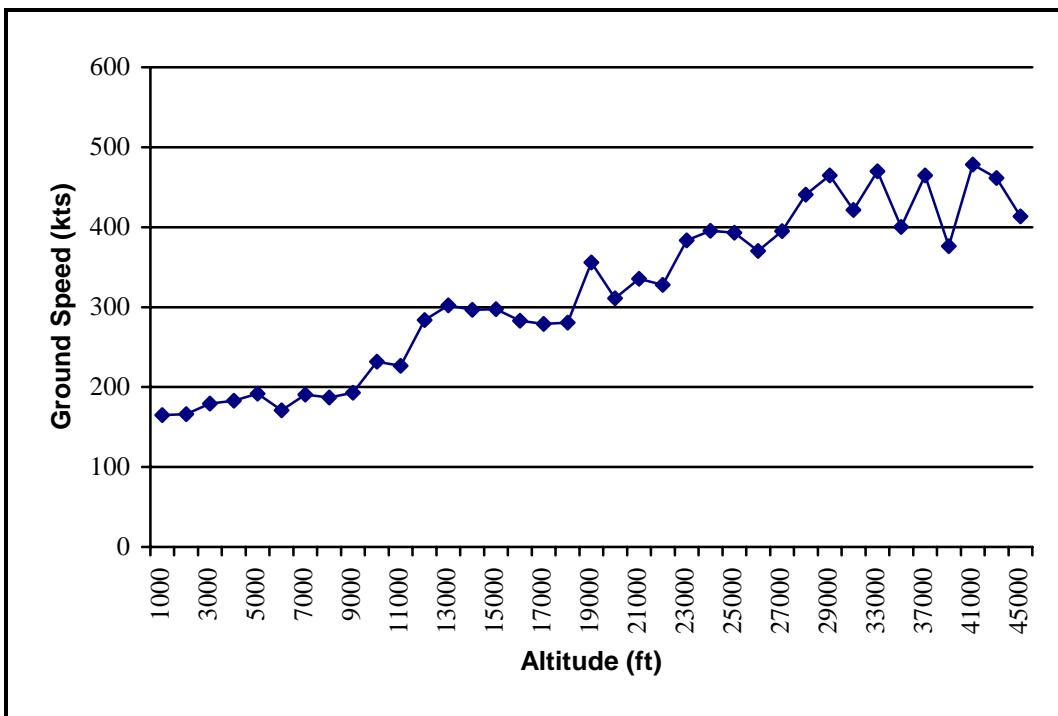


Figure 13: Average Ground Speed by Altitude for Hour 3

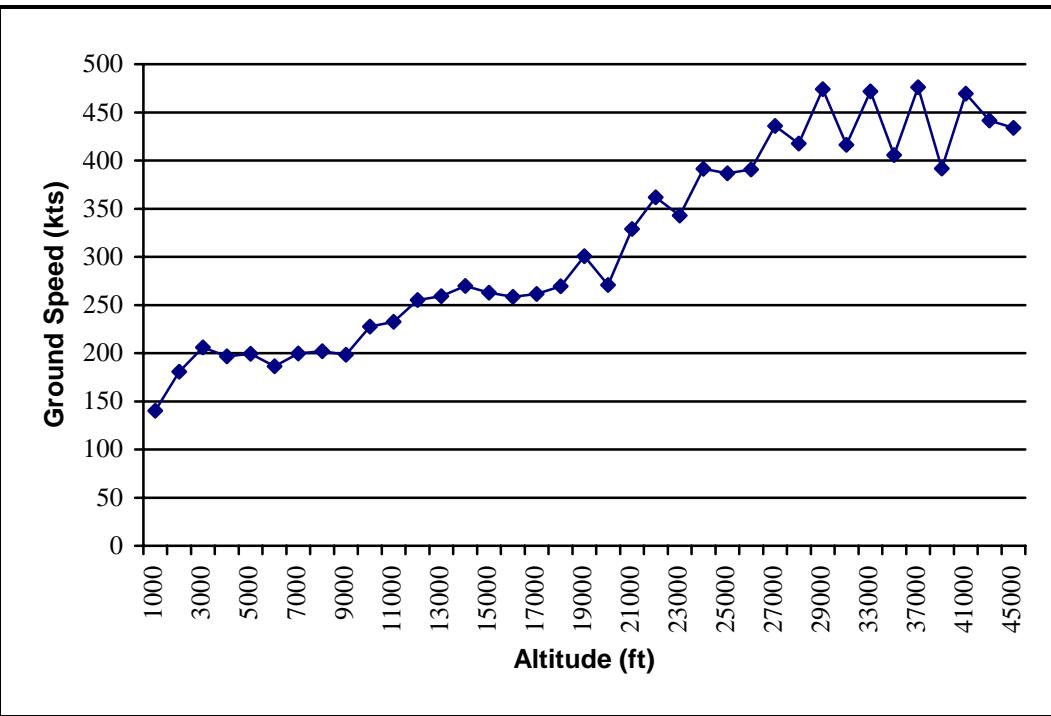


Figure 14: Average Ground Speed by Altitude for Hour 4

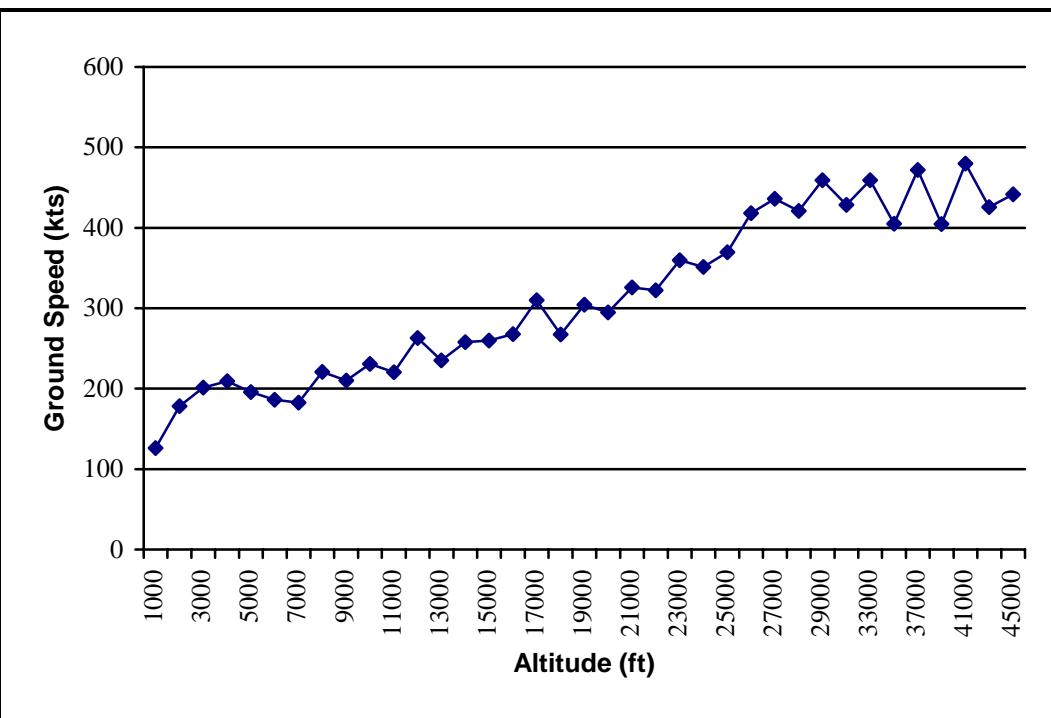


Figure 15: Average Ground Speed by Altitude for Hour 5

6.5 Center to APD Ratio

This section corresponds to Section 3.3.5 of Reference[1].

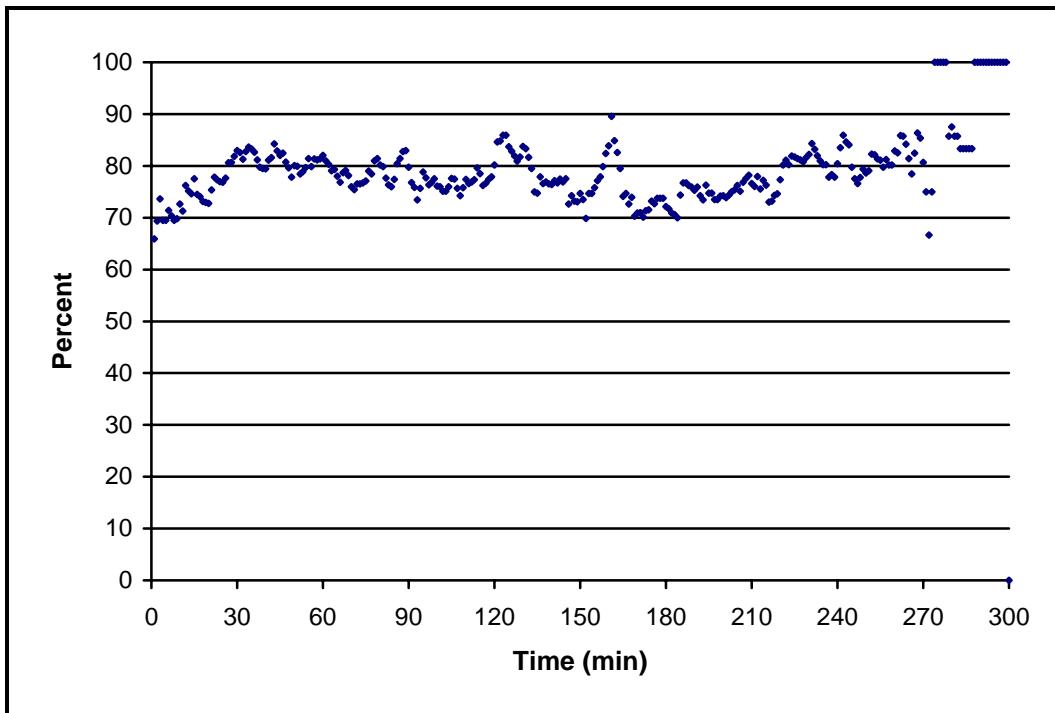


Figure 16: Percentage of Track Points in Center to APD Zone per Minute Increment

6.6 Interim Altitude Messages

This section corresponds to Section 3.3.6 of Reference[1].

Table 11: Statistics on Interim Altitude Messages⁵

Flight Count	Average	Standard Deviation	Maximum Count	Minimum Count
1068	2.866	1.149	8	1

6.7 Amendment Messages

This section corresponds to Section 3.3.7 of Reference[1]

Table 12: Statistics on Amendment Messages per Flight⁶

Flight Count	Average	Standard Deviation	Maximum Count	Minimum Count
793	2.001	1.297	10	1

⁵ Statistics on flights with interim altitude messages only

⁶ Statistics on flights with flight plan amendments only

6.8 Air Traffic Maneuvers

This section corresponds to Section 3.3.8 of Reference[1]. Detailed statistics on air traffic maneuvers are provided in Appendix C.

Table 13: Total Track Report Maneuver Count by Vertical and Horizontal Phase of Flight

Vertical Phase	Horizontal Phase of Flight		Total
	STR	TURN	
ASC	8002	1725	9727
DES	9075	1872	10947
LEV	3383	1997	20674
Total	20460	5594	26054

Table 14: Percent breakdown of Flight Tracks by Vertical and Horizontal Phase

Vertical Phase	Horizontal Phase of Flight		Margin (%)
	STR (%)	TURN (%)	
ASC	30.713	6.621	37.334
DES	34.832	7.185	42.017
LEV	12.985	7.665	79.351
Margin (%)	78.529	21.471	100.000

7 Aircraft Distributions

This section provides the metrics used to characterize the aircraft provided in the scenario. The selected metrics are aircraft type, model, navigational equipment, and the air carriers operating in the airspace. The section corresponds to Section 3.4 of Reference[1].

7.1 Aircraft Type

This section corresponds to Section 3.4.1 of Reference[1].

Table 15: Count by Aircraft Type

Aircraft Type	Count	Percentage of Total
J	1060	68.387
P	200	12.903
T	288	18.581
Unknown	2	0.129
Total	1550	100.000

7.2 Aircraft Models

This section corresponds to Section 3.4.2 of Reference[1]. A full listing and count of aircraft models is provided in Appendix D.

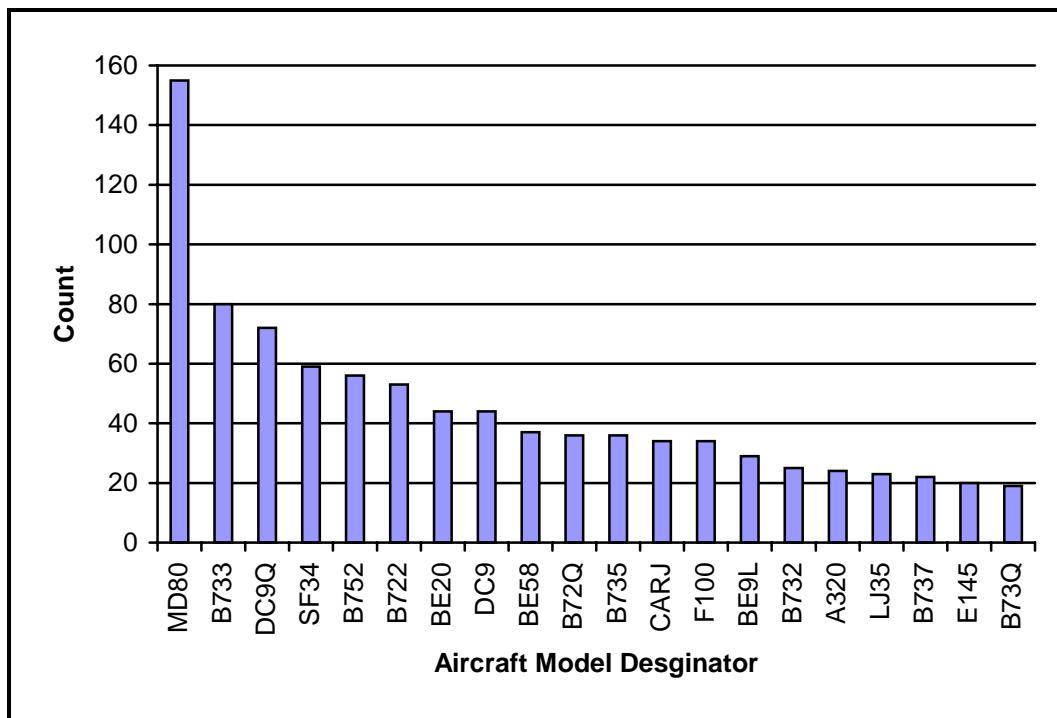


Figure 17: Count of Top Twenty Aircraft Models

7.3 Navigational Equipage

This section corresponds to Section 3.4.3 of Reference[1].

Table 16: Count by Aircraft Navigational Equipage Type

Nav. Equip. Designator	Count	Percentage of total
A	451	29.097
I	398	25.677
G	271	17.484
E	183	11.806
F	161	10.387
R	51	3.290
U	18	1.161
P	10	0.645
W	7	0.452
Total	1550	100.000

7.4 Carrier Distribution

This section corresponds to Section 3.4.4 of Reference[1].

Table 17: Count by Carrier Type

Category	Count	Percentage of Total
Commercial	970	62.581
General Aviation	515	33.226
Other ⁷	65	4.194
Total	1550	100.000

⁷ Includes military and aircraft with unrecognized designators

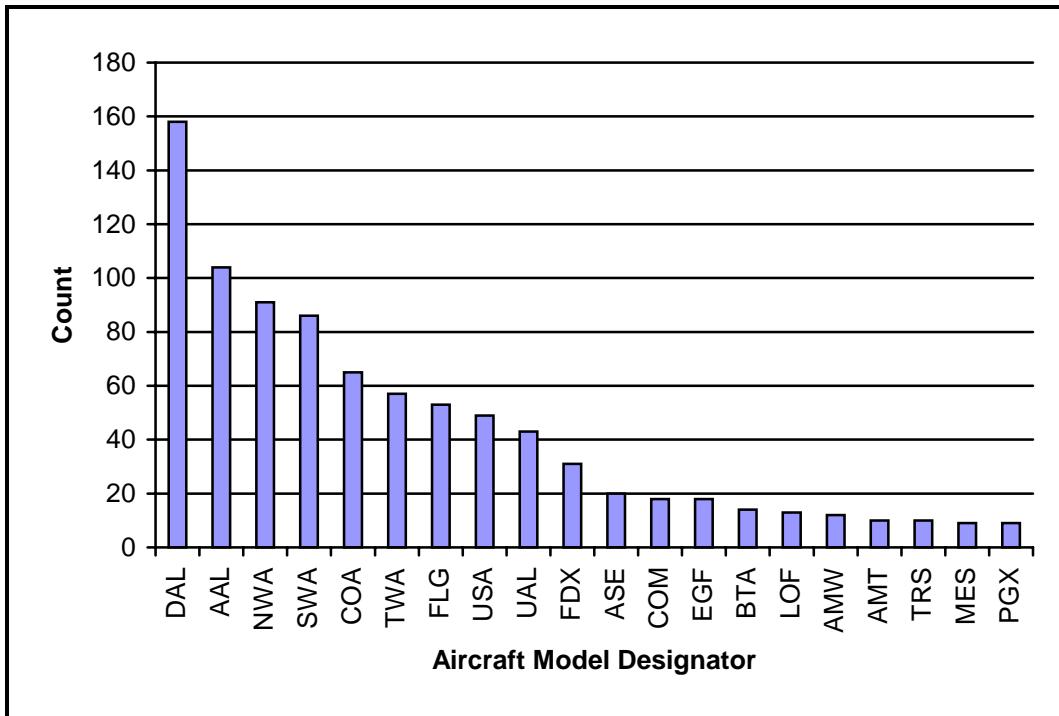


Figure 18: Count by Top Twenty Air Carriers

8 Flight Plan Adherence

This section provides statistics on lateral and vertical flight plan adherence and corresponds to Section 3.5 of Reference[1].

8.1 Lateral Flight Plan Adherence

This section corresponds to Section 3.5.1 of Reference[1].

Table 18: Statistics on Lateral Flight Plan Adherence by Altitude⁸

Upper Altitude (ft)	Flight Count	Max. Dist. Out (nm)	Min. Dist. Out (nm)	Average Dist. Out (nm)	Standard Dev.(nm)
10000	38	23	11	15.053	2.615
18000	37	30	13	18.77	2.95
33000	94	117	13	26.872	13.574
45000	41	46	14	23.573	4.226
Total	210				

8.2 Vertical Flight Plan Adherence

This section corresponds to Section 3.5.2 of Reference[1].

Table 19: Statistics on Vertical Flight Plan Adherence by Altitude⁹

Upper Altitude (ft)	Flight Count	Max. Dist. Out (ft)	Min. Dist. Out (ft)	Average Dist. Out (ft)	Standard Dev.(ft)
29000	647	31342	308	4123.022	3495.122
45000	277	25000	509	4608.398	3150.807
Total	924				

⁸ Statistics determined on tracks out of lateral adherence only.

⁹ Statistics were determined on tracks out of vertical adherence only.

9 Interfacility Traffic Flow

This section corresponds to Section 3.6 of Reference[1]. Table 20 duplicates Table 3.6-1 in reference and provides definitions for cells in Tables 21 and 22.

Table 20: Matrix of Traffic Sources in Scenario

Input - Flights into ZME		Output - Flights from ZME	
Starts in ZID		Ends in ZID	
Starts in ZME		Ends in ZME	
Starts in Other Center		Ends in Other Center	

Table 21: Statistics on Flights into ZME Airspace per minute

Input Flights	Average	Standard Deviation	Maximum Count	Minimum Count
From ZID	30.677	14.122	52	0
From ZME	58.760	28.107	111	0
From Other	97.490	44.252	178	0

Table 22: Statistics on Flights from ZME Airspace per minute

Output Flights	Average	Standard Deviation	Maximum Count	Minimum Count
To ZID	23.363	11.975	47	0
To ZME	65.690	40.844	179	0
To Other	97.873	50.961	170	0

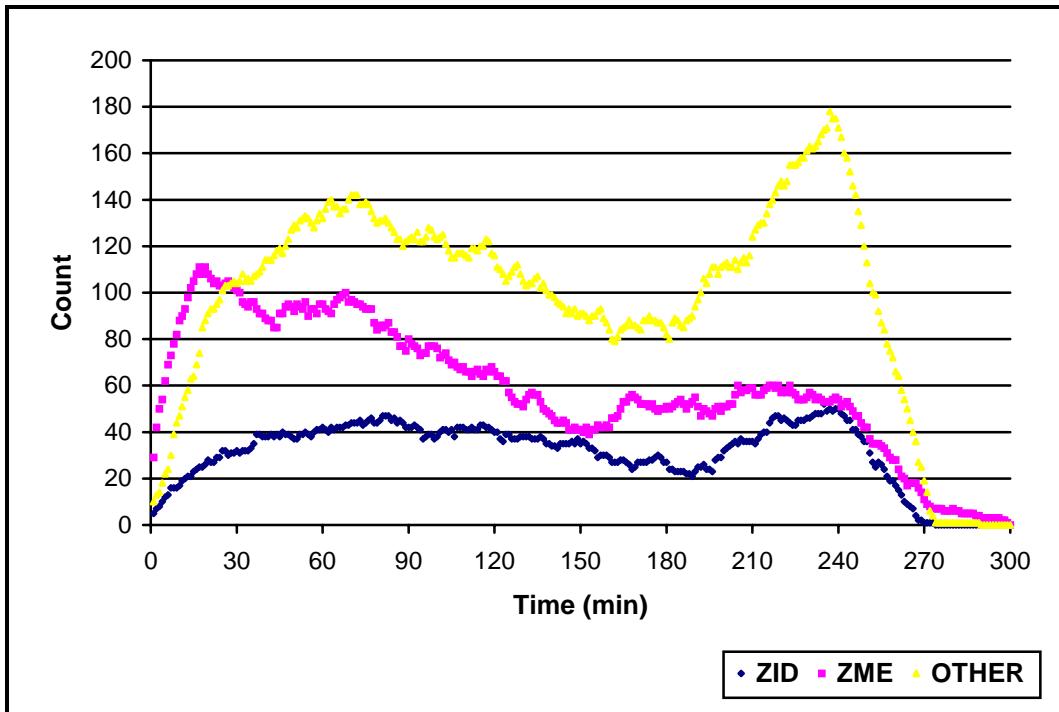


Figure 19: Flights into ZME from Legend Centers

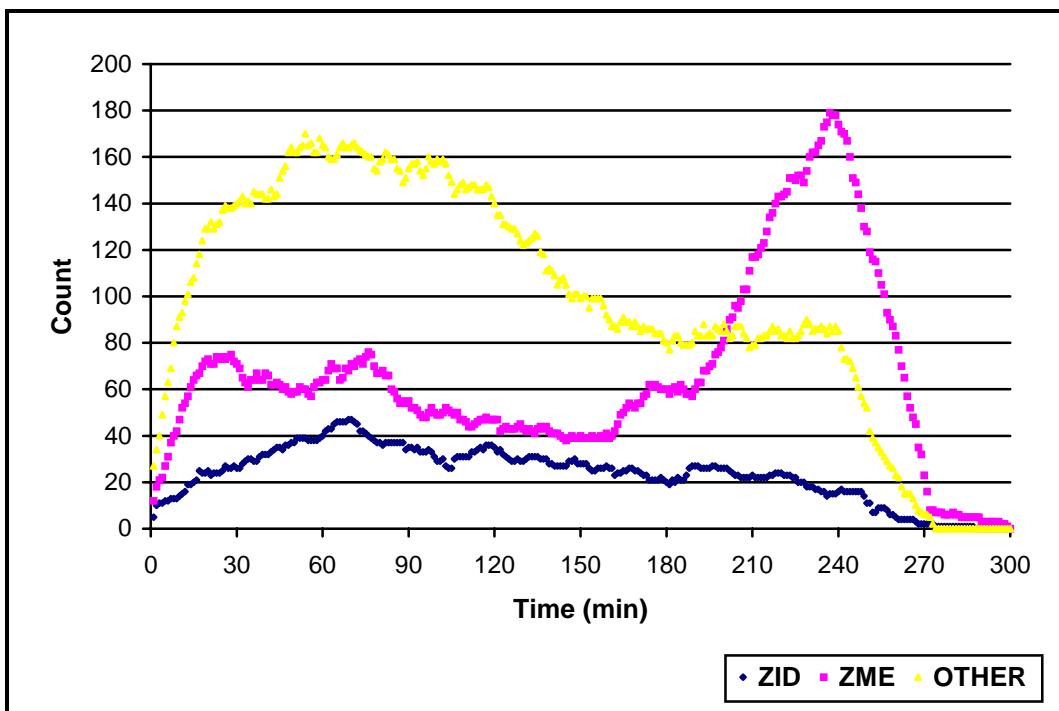


Figure 20: Flights from ZME to Legend Centers

10 Weather Variations

This section corresponds to Section 3.7 of Reference[1]. See the following document,

Kelly, Betty A., *User Request Evaluation Tool Core Capability Limited Deployment Accuracy Scenario Weather Forecast Deviation Study*, FAA William J. Hughes Technical Center / ACT-250, Atlantic City, New Jersey.

Appendix A: Supplement to Section 6.1 - Aircraft Traffic Density

Table 23: Statistics on Aircraft Encounters by Altitude Interval for All Hours

Upper Altitude (ft)	Aircraft Count	Avg. Horz. Sep.(nm)	Standard Dev.(nm)
1000	0	0.000	0.000
2000	0	0.000	0.000
3000	3	10.096	5.240
4000	10	14.489	7.764
5000	16	19.381	8.686
6000	24	16.357	7.285
7000	33	17.256	7.828
8000	9	16.021	7.656
9000	10	17.926	8.402
10000	12	15.715	5.575
11000	11	17.922	3.261
12000	9	13.963	7.101
13000	12	15.783	8.903
14000	15	16.285	8.777
15000	16	17.357	7.017
16000	25	20.289	6.714
17000	34	18.619	6.431
18000	33	18.606	7.146
19000	33	19.062	5.665
20000	33	14.929	7.730
21000	17	17.990	7.924
22000	15	16.543	7.840
23000	16	18.660	8.165
24000	19	20.029	6.385
25000	21	16.876	8.084
26000	24	16.740	8.496
27000	29	15.230	8.093
28000	64	17.715	7.596
29000	106	16.232	8.548
31000	292	16.174	8.227
33000	242	16.657	8.000
35000	207	16.570	8.308
37000	94	17.629	7.629
39000	29	14.891	8.648
41000	27	15.739	7.979
43000	2	10.053	12.438
45000	0	0.000	0.000
Total	1542		

Table 24: Statistics on Aircraft Encounters by Altitude for Hour 1

Upper Altitude (ft)	Aircraft Count	Avg. Horz. Sep.(nm)	Standard Dev.(nm)
1000	0	0.000	0.000
2000	0	0.000	0.000
3000	1	16.055	0.000
4000	5	10.513	8.868
5000	5	16.574	8.261
6000	8	17.464	7.335
7000	7	20.422	6.553
8000	1	12.459	0.000
9000	2	17.618	3.219
10000	0	0.000	0.000
11000	3	18.986	2.307
12000	3	12.219	7.343
13000	2	19.913	2.449
14000	2	20.091	11.789
15000	4	18.005	8.031
16000	6	20.703	6.878
17000	16	18.640	7.194
18000	5	17.438	7.264
19000	17	18.749	6.214
20000	12	16.706	8.235
21000	8	14.142	8.314
22000	4	13.913	10.996
23000	2	8.926	5.496
24000	7	19.609	8.243
25000	4	22.375	7.174
26000	10	17.832	8.509
27000	10	15.466	8.864
28000	17	15.640	7.921
29000	39	14.282	8.333
31000	85	17.740	8.551
33000	74	17.754	8.518
35000	50	16.021	8.597
37000	33	17.937	7.307
39000	5	13.284	9.613
41000	2	19.498	6.720
43000	0	0.000	0.000
45000	0	0.000	0.000
Total	449		

Table 25: Statistics on Aircraft Encounters by Altitude for Hour 2

Upper Altitude (ft)	Aircraft Count	Avg. Horz. Sep.(nm)	Standard Dev.(nm)
1000	0	0.000	0.000
2000	0	0.000	0.000
3000	1	8.019	0.000
4000	3	20.575	3.430
5000	7	22.057	7.271
6000	4	15.476	2.375
7000	9	19.380	8.380
8000	2	21.261	5.282
9000	0	0.000	0.000
10000	3	12.991	6.851
11000	2	15.620	4.754
12000	0	0.000	0.000
13000	6	11.515	7.793
14000	3	11.473	3.201
15000	0	0.000	0.000
16000	9	20.213	6.118
17000	9	17.913	5.528
18000	14	19.410	7.502
19000	8	19.802	4.998
20000	7	18.958	5.643
21000	5	20.140	8.022
22000	2	20.653	3.001
23000	2	27.865	0.454
24000	4	20.525	3.710
25000	3	19.426	6.300
26000	1	27.888	0.000
27000	5	13.549	11.390
28000	24	18.313	7.865
29000	28	15.589	8.411
31000	102	14.743	8.341
33000	73	16.280	7.669
35000	78	15.651	7.757
37000	25	18.467	7.458
39000	4	12.473	9.416
41000	9	17.283	9.692
43000	1	1.258	0.000
45000	0	0.000	0.000
Total	453		

Table 26: Statistics on Aircraft Encounters by Altitude for Hour 3

Upper Altitude (ft)	Aircraft Count	Avg. Horz. Sep.(nm)	Standard Dev.(nm)
1000	0	0.000	0.000
2000	0	0.000	0.000
3000	1	6.213	0.000
4000	0	0.000	0.000
5000	2	10.244	13.759
6000	6	16.949	7.420
7000	6	12.335	6.417
8000	3	13.684	9.531
9000	1	27.639	0.000
10000	4	17.143	5.085
11000	0	0.000	0.000
12000	2	17.105	6.250
13000	1	4.674	0.000
14000	2	18.271	5.827
15000	1	18.770	0.000
16000	1	24.169	0.000
17000	1	18.626	0.000
18000	2	17.287	6.998
19000	2	19.378	3.156
20000	2	9.566	0.137
21000	2	21.376	2.139
22000	5	18.088	8.279
23000	5	21.054	5.371
24000	5	21.416	5.603
25000	5	13.524	8.719
26000	4	14.056	8.778
27000	4	17.183	9.919
28000	10	16.568	8.489
29000	12	23.356	6.565
31000	39	15.348	7.899
33000	45	15.130	8.117
35000	24	18.886	8.634
37000	9	15.867	7.033
39000	5	8.631	7.178
41000	5	16.413	8.443
43000	0	0.000	0.000
45000	0	0.000	0.000
Total	216		

Table 27: Statistics on Aircraft Encounters by Altitude for Hour 4

Upper Altitude (ft)	Aircraft Count	Avg. Horz. Sep.(nm)	Standard Dev.(nm)
1000	0	0.000	0.000
2000	0	0.000	0.000
3000	0	0.000	0.000
4000	1	12.751	0.000
5000	1	27.493	0.000
6000	5	16.479	10.568
7000	10	15.586	8.346
8000	2	13.075	11.049
9000	4	13.812	10.855
10000	4	15.614	6.627
11000	5	16.903	1.702
12000	4	13.700	8.705
13000	2	27.167	1.984
14000	5	19.054	12.058
15000	11	16.993	7.349
16000	8	21.416	6.592
17000	8	19.372	6.918
18000	11	17.623	7.403
19000	4	21.408	5.355
20000	10	13.130	7.319
21000	2	24.620	2.527
22000	3	12.229	3.798
23000	4	22.301	4.634
24000	3	18.036	8.231
25000	6	11.598	6.805
26000	9	15.481	8.646
27000	8	16.420	3.532
28000	8	18.669	6.330
29000	19	15.552	9.338
31000	51	16.655	7.807
33000	44	16.739	7.870
35000	44	16.863	8.557
37000	23	16.215	8.643
39000	9	17.679	9.802
41000	7	14.767	7.445
43000	1	18.848	0.000
45000	0	0.000	0.000
Total	336		

Table 28: Statistics on Aircraft Encounters by Altitude for Hour 5

Upper Altitude (ft)	Aircraft Count	Avg. Horz. Sep.(nm)	Standard Dev.(nm)
1000	0	0.000	0.000
2000	0	0.000	0.000
3000	0	0.000	0.000
4000	1	17.852	0.000
5000	1	24.856	0.000
6000	1	6.861	0.000
7000	1	22.202	0.000
8000	1	22.008	0.000
9000	3	20.379	6.753
10000	1	18.578	0.000
11000	1	24.427	0.000
12000	0	0.000	0.000
13000	1	21.476	0.000
14000	3	12.622	7.703
15000	0	0.000	0.000
16000	1	5.609	0.000
17000	0	0.000	0.000
18000	1	26.637	0.000
19000	2	13.751	7.322
20000	2	4.526	5.929
21000	0	0.000	0.000
22000	1	24.062	0.000
23000	3	10.165	8.146
24000	0	0.000	0.000
25000	3	23.134	5.301
26000	0	0.000	0.000
27000	2	9.589	10.961
28000	5	22.667	3.680
29000	8	18.916	5.904
31000	15	17.531	6.669
33000	6	18.573	4.586
35000	11	19.364	8.945
37000	4	21.946	7.328
39000	6	18.875	4.153
41000	4	11.243	5.816
43000	0	0.000	0.000
45000	0	0.000	0.000
Total	88		

Appendix B: Supplement to Section 6.4 - Aircraft Ground Speed

Table 29: Statistics on Ground Speed by Altitude for All Hours

Upper Altitude (ft)	Distinct Aircraft	Average Speed (kts)	Standard Dev.(kts)
1000	15	152.186	28.493
2000	108	174.509	47.945
3000	293	188.245	52.751
4000	429	185.326	48.184
5000	508	188.132	53.801
6000	545	182.248	47.386
7000	575	195.631	48.888
8000	649	200.844	54.900
9000	665	201.783	55.642
10000	659	236.467	74.329
11000	644	238.015	69.599
12000	639	261.771	70.853
13000	623	263.527	67.887
14000	614	268.452	72.737
15000	613	271.425	70.395
16000	599	266.364	72.081
17000	579	273.358	70.643
18000	560	279.743	83.410
19000	542	296.371	83.365
20000	524	290.005	81.649
21000	493	327.338	71.612
22000	482	340.407	87.990
23000	476	359.115	80.958
24000	480	373.999	81.022
25000	491	380.958	82.634
26000	498	395.187	76.677
27000	506	418.368	76.032
28000	537	420.385	56.382
29000	535	459.937	59.208
31000	529	416.928	41.508
33000	453	470.130	43.479
35000	338	401.288	41.279
37000	227	471.088	53.725
39000	141	397.710	53.841
41000	88	467.868	45.363
43000	32	437.575	49.834
45000	8	457.250	34.730

Table 30: Statistics on Ground Speed by Altitude for Hour 1

Upper Altitude (ft)	Distinct Aircraft	Average Speed (kts)	Standard Dev.(kts)
1000	3	178.909	41.344
2000	19	171.010	57.981
3000	68	185.614	57.744
4000	114	176.017	49.985
5000	132	175.266	51.469
6000	141	192.144	48.277
7000	154	192.945	43.636
8000	187	204.921	52.007
9000	193	204.008	53.766
10000	191	267.608	67.719
11000	189	251.070	62.499
12000	183	268.518	67.102
13000	181	261.015	65.750
14000	181	260.475	67.652
15000	178	273.781	62.239
16000	174	269.090	67.857
17000	167	270.257	68.911
18000	157	302.749	78.259
19000	154	277.552	79.839
20000	149	284.730	73.661
21000	137	339.978	74.651
22000	136	372.288	79.691
23000	129	367.667	76.815
24000	122	368.010	77.926
25000	125	372.363	94.989
26000	124	402.869	71.585
27000	123	410.859	77.588
28000	134	399.792	79.250
29000	143	464.389	49.268
31000	150	417.333	40.855
33000	123	470.007	43.083
35000	101	400.886	31.644
37000	67	464.419	44.404
39000	33	397.244	36.751
41000	22	449.280	55.015
43000	8	445.611	38.384
45000	2	468.411	32.790

Table 31: Statistics on Ground Speed by Altitude for Hour 2

Upper Altitude (ft)	Distinct Aircraft	Average Speed (kts)	Standard Dev.(kts)
1000	6	142.037	20.771
2000	34	177.063	41.604
3000	87	184.762	48.183
4000	110	184.503	43.373
5000	140	188.471	50.961
6000	150	177.566	44.529
7000	141	202.578	48.573
8000	157	198.003	46.711
9000	158	209.091	58.522
10000	166	232.318	71.993
11000	164	253.713	69.531
12000	162	253.296	69.580
13000	160	271.403	61.669
14000	161	266.261	66.068
15000	158	271.316	68.720
16000	153	262.425	70.065
17000	154	277.938	58.301
18000	151	276.827	90.216
19000	141	284.812	73.239
20000	132	317.511	80.540
21000	128	314.331	59.665
22000	121	311.406	87.079
23000	127	344.359	78.470
24000	133	356.081	84.006
25000	140	376.524	77.570
26000	149	403.890	69.872
27000	146	422.202	64.815
28000	162	421.515	46.704
29000	161	442.153	73.770
31000	179	411.917	39.890
33000	134	471.132	45.493
35000	106	399.005	41.341
37000	72	477.574	47.106
39000	49	423.490	51.589
41000	29	464.525	51.887
43000	6	392.222	38.280
45000	1	498.699	9.207
Total	6	142.037	20.771

Table 32: Statistics on Ground Speed by Altitude for Hour 3

Upper Altitude (ft)	Distinct Aircraft	Average Speed (kts)	Standard Dev.(kts)
1000	3	164.900	16.802
2000	27	165.972	44.835
3000	71	179.280	54.755
4000	96	182.996	45.535
5000	109	191.704	62.767
6000	122	170.836	50.084
7000	126	190.653	51.830
8000	123	186.987	50.156
9000	124	192.878	58.180
10000	123	231.835	78.290
11000	116	226.360	80.216
12000	113	283.626	82.671
13000	110	302.135	85.589
14000	109	296.480	81.359
15000	111	297.291	82.046
16000	110	283.058	78.826
17000	110	278.855	75.870
18000	104	280.689	98.748
19000	101	355.641	77.099
20000	95	311.117	89.464
21000	95	335.566	60.298
22000	92	327.869	90.413
23000	96	383.631	93.170
24000	98	395.475	71.407
25000	100	392.983	92.395
26000	97	370.286	99.863
27000	99	394.996	88.882
28000	110	440.515	41.079
29000	112	464.852	56.373
31000	120	421.527	43.350
33000	115	469.869	39.278
35000	84	400.154	47.764
37000	57	464.841	65.205
39000	32	376.206	71.909
41000	23	478.288	32.599
43000	6	461.366	33.728
45000	1	413.400	3.026

Table 33: Statistics on Ground Speed by Altitude for Hour 4

Upper Altitude (ft)	Distinct Aircraft	Average Speed (kts)	Standard Dev.(kts)
1000	2	140.100	14.294
2000	21	180.606	53.904
3000	65	206.030	52.057
4000	102	196.723	51.296
5000	120	199.289	52.776
6000	139	186.214	46.794
7000	149	199.530	50.112
8000	164	201.930	60.798
9000	170	198.325	53.111
10000	166	227.619	75.015
11000	159	232.467	64.918
12000	161	255.034	66.786
13000	154	259.117	64.355
14000	151	269.671	76.489
15000	154	262.802	71.845
16000	153	258.528	69.929
17000	143	261.464	83.189
18000	143	269.570	74.477
19000	139	300.534	86.187
20000	129	270.878	81.107
21000	120	328.926	83.515
22000	117	361.695	79.818
23000	115	342.877	68.979
24000	120	391.277	77.031
25000	120	386.728	72.019
26000	117	390.654	64.610
27000	124	436.000	62.073
28000	136	417.504	58.116
29000	138	474.017	47.420
31000	144	416.137	44.499
33000	125	471.615	45.977
35000	91	405.492	43.490
37000	69	476.115	59.157
39000	44	391.560	49.277
41000	32	469.527	41.117
43000	12	441.669	51.484
45000	5	433.955	26.520

Table 34: Statistics on Ground Speed by Altitude for Hour 5

Upper Altitude (ft)	Distinct Aircraft	Average Speed (kts)	Standard Dev.(kts)
1000	1	126.000	0.000
2000	9	178.204	39.362
3000	24	201.386	42.946
4000	40	209.160	47.673
5000	45	195.657	47.005
6000	51	186.071	39.656
7000	57	182.577	47.361
8000	63	220.959	59.133
9000	64	210.123	53.799
10000	63	230.600	66.788
11000	57	220.555	58.310
12000	55	262.852	68.115
13000	54	235.260	60.123
14000	48	257.904	74.680
15000	50	259.628	67.229
16000	47	267.720	86.750
17000	41	309.934	81.816
18000	43	267.373	67.988
19000	40	304.508	87.103
20000	39	294.645	77.757
21000	38	325.684	80.373
22000	35	322.356	80.841
23000	31	359.639	70.373
24000	37	351.158	88.215
25000	35	369.610	69.151
26000	40	418.250	64.660
27000	49	435.895	73.633
28000	55	421.020	33.548
29000	50	459.344	47.696
31000	58	428.674	32.905
33000	44	459.098	38.992
35000	46	405.180	44.928
37000	37	471.759	48.253
39000	27	404.443	44.989
41000	19	480.032	29.022
43000	6	425.749	59.410
45000	3	441.771	12.845

Appendix C: Supplement to Section 6.8 - Air Traffic Maneuvers

Table 35: Count of Maneuvers by Altitude, Vertical and Horizontal Phase of Flight

Upper Altitude (ft)	Vertical Phase	Horizontal Phase of Flight	
		STR	TURN
1000	ASC	8	8
	DES	0	2
	LEV	5	7
2000	ASC	35	45
	DES	26	16
	LEV	46	55
3000	ASC	113	125
	DES	93	88
	LEV	152	137
4000	ASC	121	95
	DES	133	113
	LEV	247	164
5000	ASC	138	77
	DES	161	94
	LEV	317	138
6000	ASC	128	86
	DES	183	98
	LEV	349	107
7000	ASC	128	75
	DES	203	82
	LEV	351	93
8000	ASC	108	55
	DES	294	158
	LEV	355	81
9000	ASC	64	33
	DES	304	187
	LEV	351	66
10000	ASC	124	49
	DES	319	140
	LEV	343	77
11000	ASC	77	32
	DES	341	83
	LEV	339	62
12000	ASC	73	26
	DES	339	50
	LEV	332	40
13000	ASC	37	10
	DES	332	32
	LEV	334	33

14000	ASC	37	15
	DES	328	36
	LEV	336	34
15000	ASC	51	29
	DES	330	26
	LEV	333	37
16000	ASC	59	34
	DES	311	23
	LEV	329	33
17000	ASC	53	31
	DES	305	30
	LEV	315	29
18000	ASC	39	18
	DES	291	25
	LEV	306	31
19000	ASC	46	23
	DES	289	14
	LEV	303	31
20000	ASC	47	26
	DES	273	14
	LEV	285	38
21000	ASC	40	18
	DES	254	13
	LEV	273	34
22000	ASC	43	23
	DES	246	19
	LEV	257	30
23000	ASC	48	24
	DES	250	19
	LEV	256	44
24000	ASC	74	35
	DES	248	27
	LEV	239	36
25000	ASC	59	30
	DES	248	33
	LEV	265	51
26000	ASC	48	25
	DES	252	24
	LEV	276	48
27000	ASC	82	47
	DES	256	32
	LEV	282	52
28000	ASC	180	104
	DES	257	38

	LEV	300	58
29000	ASC	200	102
	DES	260	33
	LEV	307	54
31000	ASC	255	142
	DES	261	40
	LEV	311	52
33000	ASC	264	160
	DES	224	52
	LEV	245	43
35000	ASC	235	151
	DES	150	36
	LEV	148	32
37000	ASC	162	113
	DES	109	27
	LEV	91	16
39000	ASC	97	59
	DES	70	7
	LEV	48	14
41000	ASC	74	52
	DES	45	12
	LEV	32	8
43000	ASC	29	15
	DES	12	2
	LEV	13	5
45000	ASC	7	5
	DES	5	0
	LEV	4	2

Appendix D: Supplement to Section 7.2 - Aircraft Models

Table 36: Count and Percentage of Aircraft by Model Type

Model Type	Aircraft Count	Percent of Total
MD80	155	0.100
B733	80	0.052
DC9Q	72	0.046
SF34	59	0.038
B752	56	0.036
B722	53	0.034
BE20	44	0.028
DC9	44	0.028
BE58	37	0.024
B72Q	36	0.023
B735	36	0.023
CARJ	34	0.022
F100	34	0.022
BE9L	29	0.019
B732	25	0.016
A320	24	0.015
LJ35	23	0.015
B737	22	0.014
E145	20	0.013
B73Q	19	0.012
PA31	17	0.011
B190	16	0.010
C130	16	0.010
H25B	16	0.010
B763	15	0.010
E120	15	0.010
C560	14	0.009
C650	14	0.009
A306	13	0.008
C421	13	0.008
DC10	13	0.008
C210	12	0.008
C550	12	0.008
BE36	11	0.007
JS32	11	0.007
LJ31	11	0.007
BE30	10	0.006
BE40	10	0.006
C310	10	0.006

C182	8	0.005
JS41	8	0.005
B762	7	0.005
BE55	7	0.005
C525	7	0.005
FA10	7	0.005
GLF4	7	0.005
AC90	6	0.004
BE35	6	0.004
C340	6	0.004
C500	6	0.004
GLF2	6	0.004
L101	6	0.004
LJ25	6	0.004
M20	6	0.004
PC12	6	0.004
T38	6	0.004
AT45	5	0.003
B772	5	0.003
LJ55	5	0.003
PA32	5	0.003
PA34	5	0.003
PAY2	5	0.003
WW24	5	0.003
AT72	4	0.003
B727	4	0.003
BE33	4	0.003
C141	4	0.003
C441	4	0.003
GLF3	4	0.003
H25A	4	0.003
HS25	4	0.003
LJ60	4	0.003
P32R	4	0.003
SBR1	4	0.003
A310	3	0.002
AC95	3	0.002
AEST	3	0.002
BE10	3	0.002
C414	3	0.002
C501	3	0.002
DC87	3	0.002
FA50	3	0.002
H25C	3	0.002
H60	3	0.002

JS31	3	0.002
MD90	3	0.002
P28R	3	0.002
PA24	3	0.002
PA46	3	0.002
PAY1	3	0.002
SH33	3	0.002
SW3	3	0.002
A319	2	0.001
AC6T	2	0.001
ASTR	2	0.001
BE60	2	0.001
BE90	2	0.001
C177	2	0.001
C750	2	0.001
DC86	2	0.001
DC8Q	2	0.001
F900	2	0.001
GC1	2	0.001
KR35	2	0.001
LJ23	2	0.001
MD11	2	0.001
P210	2	0.001
P3	2	0.001
PA27	2	0.001
PAY3	2	0.001
SW2	2	0.001
SW4	2	0.001
T2	2	0.001
T37	2	0.001
A10	1	0.001
A300	1	0.001
A340	1	0.001
AC11	1	0.001
AC69	1	0.001
AT38	1	0.001
AT43	1	0.001
B2	1	0.001
B350	1	0.001
B52	1	0.001
B55	1	0.001
B721	1	0.001
B738	1	0.001
B742	1	0.001
B744	1	0.001

BE18	1	0.001
BE65	1	0.001
BE76	1	0.001
BE95	1	0.001
BE99	1	0.001
BL17	1	0.001
C12	1	0.001
C135	1	0.001
C17	1	0.001
C172	1	0.001
C180	1	0.001
C208	1	0.001
C335	1	0.001
C401	1	0.001
C402	1	0.001
C425	1	0.001
CL41	1	0.001
CL65	1	0.001
DC8	1	0.001
E6	1	0.001
F16	1	0.001
FA90	1	0.001
G2	1	0.001
G4	1	0.001
GLF5	1	0.001
L329	1	0.001
LJ45	1	0.001
LR25	1	0.001
LR35	1	0.001
M20P	1	0.001
M20T	1	0.001
MO20	1	0.001
MU2B	1	0.001
MU30	1	0.001
MXT7	1	0.001
P180	1	0.001
P28B	1	0.001
P31T	1	0.001
PA23	1	0.001
PA28	1	0.001
PA30	1	0.001
TRIN	1	0.001
Total	1550	